CLAIMS

1. A control system for controlling a plant having an operating characteristic which describes the translation of a plant input to a plant output, wherein the plant characteristic has a linear component and a non-linear component, the control system comprising a feedback control function, and a feed-forward control function, such that a demand signal is simultaneously applied to respective inputs of the feedback and feed-forward control functions and respective outputs of the feedback and feed-forward control functions are summed together to generate the plant input, the feed-forward control function having a first component which is a function of a model of the linear component of the plant characteristic, and a second component which is an adaptive function to compensate for the non-linear component of the plant characteristic, and the adaptive function being approximately modeled on the non-linear component of the plant characteristic and having adaptive laws which vary parameters of the adaptive function with time such that the adaptive function approaches the non-linear component of the plant characteristic.

2. The control system of claim 1 wherein the non-linear component of the plant characteristic is of the form:-

$$u_{ripple} = A(x)\sin(\omega x + \phi) = A_1(x)\sin(\omega x) + A_2(x)\cos(\omega x),$$

where x is the plant variable,

and where the adaptive function has the form:-

$$u_{AFC} = a_1(x(t))\sin(\omega x) + a_2(x(t))\cos(\omega x),$$

where

$$\dot{a}_1(x(t)) = -ge\sin(\omega x),$$

$$\dot{a}_2(x(t)) = -ge\sin(\omega x),$$

e is an error signal given by:-

$$e = (x_d - x),$$

g is an adaptation gain and is greater than 0, x_d is the desired function of the plant variable and ω is related to 1/period of the non-linear component of the plant characteristic, such that the adaptive feed-forward control function continuously adjusts the parameters a_1 & a_2 in response to the error signal e.

3. The system of claim 2 wherein the plant is a permanent magnet linear motor (PMLM) the plant variable x represents an instantaneous position of a translator of the linear motor, the desired function of the plant variable x_d represents the desired trajectory of the translator and the PMLM has a magnetic structure having a pole pitch x_p, such that $\omega = 2\pi / x_p$.

4. The system of claim 3 wherein the adaptation gain has a value which is greater that zero and less than or equal to one.

5. The system of claim 4 wherein the adaptation gain has a value which is less than 0.6.

6. The system of claim 5 wherein the adaptation gain has a value which is greater than or equal to 0.2.

7. The system of claim 6 wherein the adaptation gain is equal to 0.2.

8. The system as claimed in any one of claims 1 to 7 wherein the feedback controller is a PID controller as hereinbefore defined.